



AEROSPACE INFORMATION REPORT

AIR8776™

Issued

2026-03

Aircraft Tire Chine Design

RATIONALE

This document is developed to provide additional context on the subject of aircraft tire chine design, in support of AIR1904. This document does not intend to provide guidance on or a method for the design of aircraft tire chines. It only provides dedicated context on prior aircraft tire chine designs via illustration of an existing range of chined aircraft tire designs in use on various aircraft types.

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1. SCOPE

The purpose of this SAE Aerospace Information Report (AIR) is to present a sample of the range of tire chine designs approved for application on aircraft requiring non-standard water spray deflection.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside U.S. and Canada), www.sae.org.

AIR1904 Tire Spray Suppression - Airplane Design and Consideration for

2.1.2 NASA Publications

Copies of these documents are available online at <https://ntrs.nasa.gov>.

Technical Memorandum X-72695 Yager, T.J., Stubbs, S.M., and McCarty, J.L. (1975). The effect of chine tires on nose gear water-spray characteristics of a twin-engine propjet airplane. National Aeronautics and Space Administration.

2.1.3 Tire and Rim Association Publications

Available from Tire and Rim Association, Inc., 4000 Embassy Parkway, Suite 390, Akron, OH 44333, Tel: 330-666-8121, www.us-tra.org.

TRA Aircraft Year Book

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Information Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside U.S. and Canada), www.sae.org.

Daughterly, R., and Stubbs, S., "Flow Rate and Trajectory of Water Spray Produced by an Aircraft Tire," SAE Technical Paper 861626, 1986, <https://doi.org/10.4271/861626>.

2.2.2 ESDU Publications

Available from Engineering Sciences Data Unit by Accuris at www.esdu.com.

ESDU 83042 Estimation of Spray Patterns Generated from the Sides of Aircraft Tyres Running in Water or Slush

2.2.3 NASA Publications

Copies of these documents are available online at <https://ntrs.nasa.gov>.

Technical Note D-552

Horne, W.B., Joyner, U.T., and Leland, T.J.W. (1960). Studies of the retardation force developed on an aircraft tire rolling in slush or water. National Aeronautics and Space Administration.

Technical Paper No. 2718

Daugherty, R.H., and Stubbs, S.M. (1987). Measurements of flow rate and trajectory of aircraft tire-generated water spray. National Aeronautics and Space Administration.

3. HISTORICAL BACKGROUND

Aircraft tire chines, also referred to as water deflectors, are molded ribs located on the sidewall of a tire. Their function is to redirect water outward during takeoff and landing on wet runways. Chines are integrated into the tire itself and are most commonly applied to nose gear tires. In some contexts, the term “spray deflector” may also refer to separate physical components mounted to the landing gear or airframe. These are not part of the tire and fall outside the scope of this report, but the terminology is noted here for clarity.



**Figure 1 - Non-chine main landing gear tire next to a single-chine nose landing gear tire
Reprinted with permission. © Dunlop Aircraft Tyres Limited.**

The introduction of aircraft with rear-fuselage mounted engines, such as the Douglas DC-9 and Boeing 727, raised early concerns about the risk of engine spray ingestion during wet runway operations. In response, these aircraft were equipped from the outset with chined nose tires as a preventative measure to mitigate spray reaching the engine inlets.

Tire manufacturers developed these integrated water deflectors as molded features on the tire sidewall. Chines redirect water laterally, reducing the risk of aft-directed spray. For twin-wheel nose gear installations, tires are typically fitted with a single chine on the outboard sidewall. For single-wheel nose gear configurations, dual-chine tires are used to provide bilateral deflection.

A key early validation came from a 1975 NASA study documented in Technical Memorandum X-72695. In this test campaign, a twin-engine turboprop aircraft was fitted with chined and non-chined tires for comparison. The researchers found that the conventional tire produced a high spray plume that reached the engine inlets, while the chined tire created two lower lateral spray plumes that remained below the wing. The study confirmed the effectiveness of tire chines in reducing the risk of spray ingestion.

Although engine protection is the most common reason for specifying chined tires, they may also be used to mitigate spray directed at other sensitive systems, depending on the aircraft configuration and operating environment. These applications remain less common but follow the same design principles.

In some cases, chines have been fitted to main gear tires, particularly on aircraft operating in environments with standing water or loose debris. However, this is far less common than nose gear applications. One relevant example of broader spray mitigation measures is the Boeing 737-200 gravel kit. This configuration included external spray deflector panels mounted to the nose gear and protective shields on the lower fuselage to reduce the risk of debris and water spray reaching the engines and underside of the aircraft. While these components are not molded into the tires and therefore do not constitute chines, they help illustrate how spray mitigation strategies can extend beyond the nose gear and may involve a combination of integrated and external solutions.

As the technology matured through the 1980s and 1990s, chined nose tires became standard or recommended equipment on a wide range of aircraft with rear-mounted engines, including regional jets and business aircraft. Some designs, such as the McDonnell Douglas MD-80 and MD-90, employed fixed deflector panels mounted to the nose landing gear as an alternative approach.

Spray mitigation is now a required consideration in type certification. Authorities such as the FAA and EASA require demonstration that engine operation is not adversely affected during wet runway takeoff and landing. Chined tires are recognized as an effective, passive method for meeting these requirements.

Today, chined tires remain in service across many aircraft types, including those with fuselage-mounted engines or susceptible intake geometries. They continue to offer a simple, reliable solution to an operational hazard that remains relevant in both civil and military applications. Further guidance on the design and qualification of tire spray deflection devices, including chines, can be found in SAE Aerospace Information Report AIR1904.

4. HISTORICAL DEVELOPMENT OF TIRE CHINE DESIGN

The design and development of aircraft tire chines has historically been led by tire manufacturers in response to aircraft-level spray mitigation requirements. While the operational need for spray deflection is typically driven by airframe configuration, the responsibility for defining the geometry, placement, and integration of the chine lies with the tire designer. This section outlines how manufacturers have approached chine development over time, with emphasis on the legacy methods used to evaluate and refine chine performance.

4.1 Early Development

In the early decades of chine development, tire manufacturers relied on practical experimentation to evaluate competing profile designs. Without predictive simulation tools, early-stage assessment often involved the use of dedicated development molds to produce sample chine profiles for spray testing. These test articles were used in controlled splash rigs, such as shallow water troughs or rotating platforms, to compare deflection behavior under consistent conditions. Visualization methods typically included high-speed photography and dyed water to track plume shape and lateral spread.